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BUREAU OF MINES MINERALS YEARBOOK

Sodium Compounds

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UNITED STATES DEPARTMENT OF THE INTERIOR

The statistical data in this volume represents the most comprehensive, verified, domestic and international coverage for 1985 at the time the volume went to press. More recent information can be found in the monthly Sodium Compounds Mineral Industry Surveys obtainable from Publications Distribution, Bureau of Mines, Box 18070, Cochrane Mill Road, Pittsburgh, PA 15236.

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UNITED STATES DEPARTMENT OF THE INTERIOR • Donald Paul Hodel, Secretary

BUREAU OF MINES • Robert C. Horton, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

Sodium Compounds

By Dennis S. Kostick[1]

The U.S. soda ash industry took advantage of the tight supply of foreign soda ash for the world market by increasing its export sales, which reached a record-high level. Domestic consumption of soda ash decreased for the third consecutive year because of competition from recycled glass, or cullet, and continued erosion of the glass container market by polyethylene terephthalate (PET) bottles. Domestic production of natural and synthetic sodium sulfate decreased to an all-time low because of the closure of two byproduct sodium sulfate plants and the availability of inexpensive substitutive caustic soda and emulsified sulfur.

Domestic Data Coverage.—Domestic production data for soda ash and sodium sulfate are developed by the Bureau of Mines from monthly and annual voluntary surveys of U.S. operations. Of the eight soda ash operations and four sodium sulfate operations to which a survey request was sent, all responded, representing 100% of the total production data shown in table 1. Two soda ash producers did not report sales value on these forms; however, their data were estimated and included in table 1.

Table 1.—Salient sodium compound statistics

(Thousand short tons and thousand dollars)

	Soda ash		Sodium sulfate	
	1984	1985	1984	1985
United States:				
Production[1]	8,511	8,597	672	627
Value[2]	r$611,000	r$622,253	$80,433	$76,237
Exports	1,648	[3]1,771	76	119
Value	$160,774	[3]$186,064	$9,587	$11,899
Imports for consumption	17	56	265	194
Value	$2,301	$8,069	$21,198	$14,492
Stocks, Dec. 31: Producers	r322	[4]428	[5]59	[5]31
Consumption, apparent	6,864	6,777	1,050	930
World: Production	p31,126	r31,628	p4,697	r4,647

rEstimated. pPreliminary.

[1]Includes natural and synthetic. Total production data for sodium sulfate obtained from the Bureau of the Census.

[2]The value for soda ash includes synthetic soda ash. The value for synthetic sodium sulfate is based upon the average value for natural sodium sulfate.

[3]Export data from the Bureau of the Census were adjusted by the Bureau of Mines pending data reconciliation between the Bureau of the Census and the American Natural Soda Ash Corp.

[4]Includes synthetic soda ash.

[5]Natural only.

Legislation and Government Programs.—The U.S. Department of Commerce and several members of the U.S. Congress supported soda ash for inclusion on the President's Trade Strike Force. Trade barriers, such as inhibitive import permits, tariffs, embargoes, and nonenforcement of antimonopoly laws, in several countries have impeded the export efforts of the U.S. soda ash industry. These trade practices served to protect the host countries' synthetic soda ash production facilities. Whereas certain domestic mineral industries had sought and been denied Federal action for relief from low-cost imports, the soda ash industry was seeking Government support for its export efforts. Further discussions on this issue were planned for 1986.[9]

DOMESTIC PRODUCTION

Soda Ash.—The domestic industry operated at 76% of combined nameplate capacity as production of natural and synthetic soda ash increased for the third consecutive year to reach a record high despite a slight decline in the amount of Wyoming soda ash produced. Wyoming trona production by five companies was 11,796,000 million short tons, or 9% less than the record high of 12,906,000 million tons reported in 1980. This decrease was attributed to an increase in the soda ash-trona refining efficiency ratio—more tons of soda ash processed from fewer tons of trona mined—and the decrease in Wyoming soda ash production.

Acquisitions and divestitures by parent corporations affected some of the domestic soda ash companies. Chesebrough-Ponds Inc. acquired Stauffer Chemical Co.; Anaconda Minerals Co. sought a buyer for its share of a sodium carbonate deposit at Searles Lake in California; and Allied Corp. announced plans to close its 700,000-ton-per-year synthetic soda ash plant by March 1986. Allied later merged with Signal Corp. to become Allied-Signal Corp. and transferred its soda ash operations to the Henley Group, a newly formed spinoff company. Allied's announcement prompted Church & Dwight Co. Inc., the Nation's largest sodium bicarbonate manufacturer, to cease production at its 96,000-ton-per-year facility, which used sodium carbonate from Allied as feedstock.

Kerr-McGee Chemical Corp. announced that all soda ash production would be phased out at its Searles Lake Westend facility by 1987. The plant has had a capacity of about 150,000 tons per year. FMC Wyoming Corp. began solution mining commercial quantities of soda ash. Upon reaching full-scale production planned for 1987, the operation was expected to have more than 250,000 tons per year of soda ash capacity, which would replace a comparable amount of underground mining capacity.

Table 2.—Producers of soda ash and natural sodium sulfate in 1985

Product and company	Plant nameplate capacity (thousand short tons)	Plant location	Source of sodium
Soda ash, natural:			
Allied Chemical Co[1]	2,200	Green River, WY.	Underground trona.
FMC Wyoming Corp	2,550	do	Do.
Kerr-McGee Chemical Corp	1,300	Argus, CA	Dry lake brine.
Do	150	Westend, CA	Do.
Stauffer Chemical Co. of Wyoming[2]	1,960	Green River, WY.	Underground trona.
Tenneco Minerals Co	1,900	do	Do.
T. G. Soda Ash Inc	1,100	Granger, WY	Do.
Soda ash, synthetic:			
Allied Chemical Co.[3]	700	Syracuse, NY	Ammonia-soda process.
Total	11,260		
Sodium sulfate:			
Great Salt Lake Minerals & Chemicals Corp.[4]	50	Ogden, UT	Salt lake brine.
Kerr-McGee Chemical Corp	240	Westend, CA	Dry lake brine.
Ozark-Mahoning Co	70	Brownfield, TX.	Subterranean brine.
Do	150	Seagraves, TX	Do.
Total	510		

[1]Allied Corp. merged with Signal Corp. to become Allied-Signal Corp.
[2]Acquired by Chesebrough-Ponds Inc.
[3]Plant was downrated from 900,000 tons per year in Jan. 1983.
[4]Solar ponds were flooded May 5, 1984. No significant production in 1985.

Sodium Sulfate.—Allied-Signal permanently closed its sodium bichromate and byproduct sodium sulfate facility at Baltimore, MD, at midyear. Climax Chemical Corp. modified its Grantsville, UT, plant to produce potassium sulfate instead of sodium sulfate. These actions resulted in the loss of about 135,000 tons of sodium sulfate annual capacity.

Table 3.—Synthetic and natural sodium carbonates produced in the United States

(Thousand short tons and thousand dollars)

Year	Synthetic soda ash (ammonia-soda process)[1]	Natural sodium carbonates[2]		Total quantity
	Quantity	Quantity	Value[3]	
1981	W	W	787,469	8,281
1982	W	W	721,257	7,819
1983	W	W	e685,100	8,467
1984	W	W	e611,000	8,511
1985	W	W	e622,253	8,597

eEstimated. W Withheld to avoid disclosing company proprietary data.
[1]Includes quantities used to manufacture caustic soda, sodium bicarbonate, and finished light and dense soda ash.
[2]Soda ash and trona (sesquicarbonate).
[3]Includes value for synthetic soda ash.

Table 4.—Synthetic and natural sodium sulfate[1] produced in the United States

(Thousand short tons and thousand dollars)

Year	Synthetic and natural[2] (quantity)			Natural	
	Lower purity[3] (99% or less)	High purity	Total[4]	Quantity	Value
1981	666	445	1,111	608	43,186
1982	463	401	864	W	W
1983	427	427	855	423	39,425
1984	r428	r444	872	435	40,125
1985	401	428	827	389	35,860

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]All quantities converted to 100% Na_2SO_4 basis.
[2]Current Industrial Reports, Inorganic Chemicals, Bureau of the Census.
[3]Includes Glauber's salt.
[4]Data may not add to totals shown because of independent rounding.

CONSUMPTION AND USES

Soda Ash.—Increased use of PET containers by the food and beverage industries continued to inhibit sales of soda ash to the glass container industry. Approximately 1.3 million tons of cullet collected for reuse also reduced soda ash sales. These losses were offset by the strength of the construction and automotive industries, which were major consumers of fiberglass and of flat glass, accounting for 55% and 20% of the total flat glass market, respectively. As automobile manufacturers strive to reduce vehicle weight and thereby gasoline consumption, the quantity of glass per vehicle was forecast to decrease nearly 13% by 1992.[3]

Liquid detergents have become increasingly popular among consumers because of their convenience. In 1985, the market share of liquid home detergents increased 5% over that of 1984 and represented 30% of the home detergent market. Because powdered detergents contain soda ash in their formulations, but liquid detergents do not, the increasing preference for liquid detergents was expected to constrain domestic soda ash demand. The use of soda ash in the manufacture of sodium tripolyphosphate (STPP) for powdered detergents increased 4% in 1985, despite the ban of STPP in one-fourth of the States because of

environmental considerations.

Sodium Sulfate.—Apparent consumption decreased to an all-time low because of competition from inexpensive and available caustic soda and emulsified sulfur, which were substituted for low-purity sodium sulfate, known as saltcake, in the pulp and paper industry. In addition, the use of sodium sulfate declined in glass container manufacturing and in detergent production. Sodium sulfate had been used as a filler in powdered detergent formulations, but most manufacturers were removing fillers and replacing them with additional builders, such as STPP. Liquid detergents do not contain sodium sulfate in their composition.

Table 5.—Estimated consumption of soda ash in the United States, by end use

(Thousand short tons)

End use	1984	1985
Glass:		
Bottle and container	2,300	2,200
Flat	600	700
Fiber	250	275
Other	250	225
Total	3,400	3,400
Chemicals	1,550	1,500
Soaps and detergents	600	600
Pulp and paper	350	350
Water and stackgas	600	600
Other[1]	464	327
Total	3,464	3,377
Grand total	6,864	6,777

[1]Includes soda ash used in petroleum and metal refining, leather tanning, enamels, etc.

STOCKS

Soda Ash.—Yearend stocks of dense and light soda ash in plant silos, warehouses, terminals, and on teamtracks amounted to 428,000 tons, or 33% more than 1984 yearend inventories.

Sodium Sulfate.—Inventories of natural sodium sulfate decreased 47%, primarily because of reduced domestic industry production capability and weak domestic demand.

PRICES

Soda Ash.—In mid-1985, the soda ash industry reduced the temporary voluntary allowance on soda ash from $11 to $7 per ton. This action effectively raised the f.o.b. price per ton from $79 to $83 in Wyoming and from $109.25 to $113.25 in California. The average annual value of natural soda ash, f.o.b. Green River, WY, and Searles Valley, CA, was estimated to be $67.82 per ton.

Sodium Sulfate.—The average annual value of bulk natural product, f.o.b. mine or plant, was $92.19 per ton.

Table 6.—Sodium compounds yearend prices

		1984	1985
Sodium carbonate (soda ash):			
Light, paper bags, carlots, works	per ton	$150.00	$150.00
Light, bulk, carlots, works	do.	123.00	123.00
Dense, paper bags, carlots, works	do.	120.00	120.00
Dense, bulk, carlots, works	do.	90.00	90.00
Sodium sulfate (100% Na_2SO_4):			
Technical detergent, rayon grade, bags, carlots	do.	$90.00-96.00	$90.00-96.00
Sodium sulfate, bulk, carlots, works[1]	do.	113.00-114.00	113.00-114.00
Domestic salt cake, bulk, works[1]	do.	47.00-53.00	47.00-53.00
National Formulary (N.F. XII), drums	per pound	.235	.235

[1]East of Mississippi River.

Source: Chemical Marketing Reporter. Current Prices of Chemicals and Related Materials. V. 226, No. 27, Dec. 31, 1984, p. 27, and v. 227, No. 27, Dec. 30, 1985, p. 27.

FOREIGN TRADE

Soda Ash.—Exports of 1.639 million tons of soda ash reported by the Bureau of the Census were adjusted to include an additional 132,000 tons, pending data reconciliation between the Bureau of the Census and the American National Soda Ash Corp. Total exports, as adjusted by the Bureau of Mines, were 1.771 million tons. Exports to 43 countries, on a regional basis, were as follows: Asia, 60%; North America, 14%; Latin America, 12%; Africa, 9%; Oceania, 3%; and the Caribbean and Europe, 1% each.

At yearend, the Republic of Korea agreed to lift import controls on 603 products, including soda ash, over the following 3 years. This action offered potential for increasing U.S. exports.

Four companies comprising the Japanese synthetic soda ash industry considered filing dumping charges against U.S. producers. The Japanese claimed that U.S. soda ash consumers paid $92 per ton at the mine whereas exports to Japan were priced at $66 per ton.[4]

Table 7.—U.S. exports of sodium carbonate and sodium sulfate

(Thousand short tons and thousand dollars)

Year	Sodium carbonate		Sodium sulfate	
	Quantity	Value[1]	Quantity	Value[1]
1982	1,109	140,616	111	12,162
1983	1,686	154,584	91	11,380
1984	1,648	160,774	76	9,587
1985	[2]1,771	[2]186,064	119	11,899

[1]Free alongside ship (f.a.s.) value at U.S. port.
[2]Adjusted by the Bureau of Mines to account for discrepancies in data.

Source: Bureau of the Census.

Table 8.—U.S. imports for consumption of sodium sulfate

(Thousand short tons and thousand dollars)

Year	Crude (salt cake)[1]		Anhydrous		Total[1]	
	Quantity	Value[2]	Quantity	Value[2]	Quantity	Value[2]
1982	210	13,820	184	14,938	394	28,758
1983	144	10,312	199	17,609	343	27,921
1984	61	4,223	204	16,975	265	21,198
1985	40	2,549	154	11,943	194	14,492

[1]Includes Glauber's salt as follows: 1982—2 tons ($1,241); 1983—3 tons ($1,648); and 1984—12 tons ($4,997).
[2]Customs, insurance, and freight (c.i.f.) value at U.S. port.

Source: Bureau of the Census.

Table 9.—U.S. imports for consumption of sodium carbonate

	1984		1985	
	Quantity (short tons)	Value[1] (thousands)	Quantity (short tons)	Value[1] (thousands)
Sodium carbonate, calcined	16,659	$2,292	56,198	$8,085
Sodium carbonate, hydrated, and sesquicarbonate	5	9	4	4
Total	16,664	2,301	56,202	8,089

[1]Customs, insurance, and freight (c.i.f.) value at U.S. port.

Source: Bureau of the Census.

WORLD REVIEW

Egypt.—At midyear, MISR Chemical Industries Co., the Nation's sole soda ash producer, elected Chemieanlagen Co. of the German Democratic Republic and Krebs and Co. of France as engineering contractors for the proposed expansion of production capacity at the El Mex synthetic soda ash facility. If completed, the project could increase total capacity from 80,000 tons to 200,000 tons per year.[5]

India.—The Government reduced duties from 70% to 35% on light soda ash imports and from 70% to 15% on dense soda ash imports. These duty reductions were in response to a surge in soda ash demand by the Indian detergent industry and soda ash supply problems. The light soda ash duty was expected to be reduced to 25% in early 1986. Less expensive imports were expected to ease the supply imbalance temporarily. In addition, in 1985 approval was granted to construct five new synthetic soda ash plants to increase India's production capability.[6]

Turkey.—Progress continued toward development of the Baypazari trona deposit as FMC and Etibank, the state-owned mining company, each agreed to have a 35% equity share in the venture; the International Bank for Reconstruction and Development held 10%, and private Turkish investors held the remainder. Turkey has been an associate member of the European Economic Community. Full member status by the early 1990's when the project is targeted for completion could provide FMC with a competitive advantage for supplying soda ash to western European markets.[7]

Table 10.—Sodium carbonate: World production, by country[1]

(Short tons)

Country	1981	1982	1983	1984[p]	1985[e]
Albania[e]	27,600	r29,700	r30,800	r33,000	34,100
Australia[e]	330,000	330,000	330,000	330,000	330,000
Austria[e]	190,000	190,000	190,000	165,000	165,000
Belgium	300,931	361,170	286,340	451,224	500,000
Brazil	207,234	219,360	231,485	e210,000	210,000
Bulgaria	1,618,948	1,607,940	1,400,918	e1,610,000	1,610,000
Canada[e]	500,000	500,000	470,000	400,000	385,000
Chad[e 3]	5,500	5,500	NA	NA	NA
Chile[e]	11,000	NA	NA	NA	NA
China	1,821,016	1,911,406	1,976,442	e2,070,000	2,200,000
Colombia	r117,087	122,136	130,392	142,683	140,000
Czechoslovakia	130,293	117,313	104,694	111,711	110,000
Denmark[3]	164	131	139	139	138
Egypt	25,754	45,496	47,399	e45,000	45,000
France[e]	1,765,000	r1,100,000	r1,100,000	r990,000	990,000
German Democratic Republic	967,828	972,237	977,749	981,056	990,000
Germany, Federal Republic of	1,310,647	1,218,053	1,342,614	1,503,551	1,600,000
Greece[e]	1,100	1,100	1,100	1,100	1,100
India	e676,000	646,836	820,481	915,869	850,000
Italy[e]	105,000	100,000	95,000	100,000	100,000
Japan	1,298,185	1,281,323	1,216,265	1,142,140	1,290,000
Kenya[3]	275,578	176,855	213,506	249,177	250,000
Korea, Republic of	222,736	204,666	254,193	273,292	e276,559

See footnotes at end of table.

Table 10.—Sodium carbonate: World production, by country[1] —Continued

(Short tons)

Country	1981	1982	1983	1984[p]	1985[e]
Mexico[3]	442,026	429,901	[e]440,000	466,300	[4]504,000
Netherlands[e]	460,000	460,000	460,000	440,000	440,000
Norway	(5)	(5)	(5)	(5)	--
Pakistan	[r]111,507	[r]109,254	[r e]112,400	[r e]135,000	130,000
Poland	771,617	822,323	909,406	1,011,921	940,000
Portugal[e]	190,000	190,000	180,000	165,000	165,000
Romania	1,020,739	959,010	868,620	881,848	890,000
Spain[e]	550,000	550,000	550,000	610,000	610,000
Sweden[e]	(5)	(5)	(5)	(5)	--
Switzerland[e]	51,000	[r]50,000	50,000	49,000	50,000
Taiwan	79,437	65,279	103,419	118,179	110,000
Turkey[e]	65,000	65,000	[r]65,000	[r]65,000	65,000
U.S.S.R.	5,357,227	5,250,303	5,620,679	5,639,418	5,730,000
United Kingdom[e]	1,430,000	1,430,000	1,430,000	[r]1,100,000	1,100,000
United States[3]	8,281,495	7,819,083	8,467,118	8,511,359	[4]8,597,180
Yugoslavia	162,212	200,488	202,135	207,555	[4]220,053
Total	[r]30,879,861	[r]29,541,863	30,678,314	31,125,522	31,628,130

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through May 6, 1986. Synthetic unless otherwise specified.
[2]Natural only.
[3]Production for sale only; excludes output consumed by producers.
[4]Reported figure.
[5]Includes natural and synthetic.
[6]Revised to zero.

Table 11.—Sodium sulfate: World production, by country[1]

(Thousand short tons)

Country[2]	1981	1982	1983	1984[p]	1985[e]
Natural:					
Argentina	57	47	50	[e]50	41
Canada	590	603	500	[e]427	413
Chile[3]	(4)	1	1	1	1
Egypt	[e]3	3	2	[e]2	2
Iran[e]	11	11	13	13	13
Mexico[3]	[r]465	[r]519	436	456	463
South Africa, Republic of	5	3	1	1	(4)
Spain	297	232	345	405	364
Turkey	73	72	68	92	94
U.S.S.R.[e]	386	297	297	397	408
United States	608	[r]W	423	435	[e]389
Total	[r]2,405	[r]1,888	2,236	2,279	2,191
Synthetic:					
Austria[e]	61	61	61	55	55
Belgium[e]	276	276	276	276	287
Chile[e]	64	52	57	63	61
Finland[e]	[r]44	[r]44	[r]39	[r]39	39
France[e]	165	165	165	[r]132	138
German Democratic Republic	141	157	168	181	182
Germany, Federal Republic of	281	236	138	141	149
Greece	[r]11	[r]8	[r e]9	[r e]10	10
Hungary[e]	11	11	11	11	11
Italy[e]	99	94	99	[r]88	88
Japan	314	282	287	307	320
Netherlands[e]	55	55	55	50	50
Portugal[e]	[e]64	63	62	55	55
Spain[e, 10]	193	187	187	187	176
Sweden[e]	[r]110	[r]110	[r]110	[r]110	110

See footnotes at end of table.

Table 11.—Sodium sulfate: World production, by country[1] —Continued

(Thousand short tons)

Country[2]	1981	1982	1983	1984[p]	1985[p]
Synthetic: —Continued					
U.S.S.R.[e 9]	276	276	276	276	287
United States[11]	503	[r]864	432	437	[e]438
Total	[r]2,668	[r]2,941	2,432	2,416	2,456
Grand total	[r]5,073	[r]4,829	4,668	4,697	4,647

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Table includes data available through May 6, 1986.

[2]In addition to the countries listed, China, Norway, Poland, Romania, Switzerland, and the United Kingdom are known to or are assumed to have produced synthetic sodium sulfate, and other unlisted countries may have produced this commodity, but production figures are not reported, and available general information is not adequate for the formulation of reliable estimates of output levels.

[3]Natural mine output, excluding byproduct output from the nitrate industry, which is reported separately under "Synthetic" in this table.

[4]Less than 1/2 unit.

[5]Series reflects output reported by Industrias Peñoles S.A. de C.V., Mexico's principal producer, plus an additional 22,000 short tons (estimated) by a smaller producer.

[6]Conjectural estimates based on 1968 information on natural sodium sulfate and general economic conditions.

[7]Natural sodium sulfate included with synthetic sodium sulfate production.

[8]Reported figure.

[9]Byproduct of nitrate industry.

[10]Quantities of synthetic sodium sulfate credited to Spain are reported in official sources in a way such as to indicate that they are in addition to the quantities reported as mined (reported in this table under "Natural"), but some duplication may exist.

[11]Derived approximate figures; data presented are the difference between reported total sodium sulfate production (natural and synthetic not differentiated) and reported natural sodium sulfate sold by producers (reported under "Natural" in this table).

TECHNOLOGY

FMC designed and built a flue gas desulfurization unit that was installed at year-end, with the cooperation of the City of Colorado Springs Department of Utilities, on a coal-fired boiler at the Nixon powerplant in Fountain, CO. The scrubbing agent, sodium sesquicarbonate, reacted with sulfur oxide emissions from the burning coal to form sodium sulfite and sodium sulfate. Reducing sulfur oxide emissions by 70% is required to comply with new Environmental Protection Agency standards and Colorado air quality regulations. Eventually, sodium bicarbonate and trona also were to be tested as scrubbing agents. Proof of the economic effectiveness of any of these commodities as desulfurizing mediums could be a significant boon to the Wyoming soda ash industry, which has sustained stagnant or declining domestic soda ash demand.[1]

Ontario Paper Co. at Thorold, Ontario, Canada, developed a process to produce sodium bicarbonate as a byproduct of pulp and paper manufacturing. By reacting carbon dioxide with a solution containing sodium carbonate and sodium sulfate, which usually are recovered and recycled in a pulp and paper operation, the sodium carbonate was converted to sodium bicarbonate and the sodium sulfate could be separated subsequently by fractional crystallization. A substantial increase in domestic sodium bicarbonate demand could promote the use of this technique in U.S. pulp mills.[2]

[1]Physical scientist, Division of Industrial Minerals.

[2]U.S. Senate. Barriers to U.S. Exports. Congr. Rec., v. 131, No. 177, Dec. 19, 1985, pp. S18380-S18385.

[3]Chemical Week. In New Cars, Plastics Are Taking the Driver's Seat. V. 137, No. 17, 1985, pp. 6-8.

[4]Glass Industry. Japanese Producers Charge Soda Ash Dumping. V. 66, No. 13, 1985, p. 10.

[5]Industrial Minerals (London). Egyptian Soda Ash Plant Retrofit. No. 216, 1985, p. 94.

[6]European Chemical News. V. 45, No. 1196, 1985, p. 9.

[7]Industrial Minerals (London). Soda Ash Progress. No. 220, 1986, p. 11.

[8]———. Trona in Desulfurization. No. 222, 1986, p. 25.

[9]Corpus Chemical Report. Ontario Paper Considering Sodium Bicarbonate Project. V. 17, No. 38, Sept. 23, 1985, p. 1.

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